REMARKS

Claims 1-31, 52, and 54-62 are pending in the application with claims 1 and 52 amended herein. Applicant expresses appreciation for the allowance of claims 56, 57, and 59 and for the indication that claims 10, 11, and 28 set forth allowable subject matter. Applicant notes that the Office Action Summary lists claim 57 as rejected even though page 11 of the Office Action lists claim 57 as allowed. Since claim 57 depends from claim 56, Applicant presumes that the Office's intent was to allow claim 57.

Claims 1, 2, 6-9, 12-14, 16-18, 52, 61, and 62 stand rejected under 35 U.S.C. 102(e) as being anticipated by Tsunashima. Applicant requests reconsideration.

Claim 1 sets forth a method of forming a dielectric layer that includes, among other features, forming a first metal-containing dielectric layer consisting of metal oxide over a silicon-containing surface of a substrate and forming a second metal-containing dielectric layer consisting of metal oxide on and in contact with the first metal-containing dielectric layer. All of the metal of the first dielectric layer consists of at least one element selected from Group IVB. All the metal of the second dielectric layer consists of at least one element selected from Group IIIB. Page 2 of the Office Action alleges that Tsunashima discloses each and every limitation of claim 1. Applicant traverses.

Applicant asserts that Tsunashima clearly fails to disclose every limitation of claim 1. Page 2 of the Office Action incorrectly alleges that metal silicate film 6 of Tsunashima consists of metal oxide. Column 4, lines 60-63 and column 5, lines 24-30 of Tsunashima require metal silicate film 6 to include silicon in addition to a metal and oxygen. As known to those of ordinary skill, silicon is not a metal. Accordingly, metal silicate film 6 does not "consist" of metal oxide.

In contrast, claim 1 sets forth "a first metal-containing dielectric layer consisting of metal oxide." The term "containing" in the phrase "a first metal-containing dielectric layer" is inclusive and does not exclude additional, unrecited features. Thus, the dielectric layer is not limited to containing only metal. However, the phrase "consisting of metal oxide" further limits the composition of the dielectric layer by excluding any composition other than metal oxide. Such dielectric layer may include Group IVB metals, but does not necessarily consist of oxides of metal selected from Group IVB. Since metal silicate film 6 includes silicon, such film does not disclose the first metal-containing dielectric layer set forth in claim 1. At least for the reasons indicated herein, Tsunashima does not anticipate claim 1. Claims 2, 6-9, 12-14, and 16-18 depend from claim 1 and are not anticipated at least for such reason as well as for the additional limitations of such claims not disclosed.

Page 6 of the Office Action acknowledges that Tsunashima does not expressly disclose metal silicate film 6 as consisting of hafnium oxide and relies upon Ma as allegedly disclosing gate dielectric 120 as consisting of hafnium oxide. The Office Action alleges that modification of Tsunashima by substituting metal silicate film 6 with gate dielectric 120 of Ma constitutes mere substitution of art-recognized equivalents. However, column 1, lines 39-41 of Tsunashima expressly state that using a metal oxide film as the gate insulating film makes it difficult to obtain a good interface that is free from distortion. Accordingly, the focus in Tsunashima is upon using a metal silicate film at the interface with a silicon substrate. Thus, the substitution proposed in the Office Action to replace metal silicate film 6 with the hafnium oxide gate dielectric 120 of Ma directly contradicts the teachings of Tsunashima.

The mere fact that Tsunashima can be modified does not make the modification obvious unless the prior art suggests the desirability of the modification. If a proposed modification of Tsunashima renders the prior art device inoperable for its intended purpose, then no suggestion or motivation exists to make the proposed modification. Only the Applicant's own specification recognizes the advantages of the dielectric layer set forth in claim 1 that provides first and second metal-containing dielectric layers with the first layer consisting of metal oxide and contacting the silicon-containing surface. At least for such reason, the modification proposed in the Office Action is improper.

Claim 52 sets forth a method of forming a dielectric layer that includes, among other features, forming a first metal-containing dielectric layer over a silicon-containing surface of a substrate and forming a second metal-containing dielectric layer on and in contact with the first metal-containing dielectric layer. The first dielectric layer consists essentially of hafnium oxide. The second dielectric layer consists essentially of lanthanum oxide. Page 4 of the Office Action alleges that Tsunashima discloses each and every limitation of claim 52. Applicant traverses.

Pursuant to MPEP 2111.03, the transitional phrase "consisting essentially of" limits the scope of claim 52 to the specified materials and those that do not materially affect the basic and novel characteristics of the claimed method. Column 4, lines 60-63 and column 5, lines 24-30 of Tsunashima require metal silicate film 6 to include silicon in addition to a metal and oxygen. Further, column 1, lines 39-41 of Tsunashima expressly state that using a metal oxide film as the gate insulating film makes it difficult to obtain a good interface that is free from distortion. Accordingly, Tsunashima establishes that using a metal silicate film at the interface with a silicon substrate has a material effect in comparison to using a metal oxide film at such interface. At least for

such reasons, Applicant asserts that Tsunashima cannot be considered to disclose the first dielectric layer "consisting essentially" of hafnium oxide set forth in claim 52.

Claims 60 and 61 depend from claim 52 and are not anticipated at least for such reason as well as for the additional limitations of such claims not disclosed or suggested. For example, claim 60 sets forth that the first dielectric layer "consists" of hafnium oxide. As may be appreciated from the discussion above regarding the deficiencies of Tsunashima as applied to claim 1, such reference fails to disclose each and every limitation of claim 60.

Applicant notes that page 4 of the Office Action rejects claim 62, apparently presuming that it depends from claim 52. However, Applicant notes that claim 62 depends from claim 3. Accordingly, the Applicant asserts that claim 62 is patentable as may be appreciated from the discussion below regarding claim 3.

As established herein, Applicant asserts that Tsunashima does not anticipate claims 1, 2, 6-9, 12-14, 16-18, 52, 60, and 61 and requests allowance of such claims in the next Office Action.

Claims 1 and 52 stand rejected under 35 U.S.C. 102(e) as being anticipated by Yao. Applicant requests reconsideration.

The subject matter of claim 1 and 52 is discussed above. Additionally, claims 1 and 52 are amended herein to set forth including the first and second metal-containing dielectric layers in an integrated circuit device. Page 4 of the Office Action alleges that Yao discloses each and every limitation of claims 1 and 52. Applicant traverses.

Applicant asserts that Yao fails to disclose or suggest a method of forming a dielectric layer that includes providing the first and second metal-containing dielectric layers in an integrated circuit device. Review of column 11, line 57 to column 12, line

27 reveals that Yao merely describes a laminated structure used to pattern various electronic elements or devices. Applicant asserts that Yao fails to disclose or suggest any use of such a laminated structure within or otherwise as a part of an integrated circuit device. Applicant further asserts that the Office Action fails to reference any portion of Yao by column and line number that discloses or suggests an integrated circuit device containing the laminated structure of Yao. At least for such reason, Applicant asserts that Yao does not anticipate claims 1 or 52.

Claims 15, 19-22, 24, 25, 54, 55, and 60 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Tsunashima in view of Ma. Applicant requests reconsideration.

Claims 15 and 19 depend from claim 1 and claim 60 depends from claim 52, the subject matter of such independent claims being discussed above. As also discussed above, Ma fails to remedy the deficiencies of Tsunashima in disclosing or suggesting every limitation of claims 1 and 52. Accordingly, claims 15, 19, and 60 are patentable at least for their dependence from claims 1 and 52 as well as for the additional limitations of such claims not disclosed or suggested.

Claim 20 sets forth a method for forming a MOS transistor that includes, among other features, forming a hafnium-containing dielectric layer consisting of hafnium oxide on and in contact with a surface comprising silicon of a semiconductor substrate, forming a lanthanum-containing dielectric layer on and in contact with the hafnium-containing dielectric layer, and forming a gate electrode over the hafnium-containing and lanthanum-containing dielectric layers. Forming the hafnium-containing dielectric layer includes initially forming a hafnium-containing metal layer. Forming the lanthanum-containing dielectric layer includes initially forming a lanthanum-containing

metal layer. As may be appreciated from the discussion above regarding the deficiencies of Tsunashima in view of Ma as applied to claims 1 and 52 such combination of references fails to disclose or suggest every limitation of claim 20.

In addition, page 3 and 6 of the Office Action allege that column 6, lines 45-55 of Tsunashima disclose the claim 20 step of initially forming a hafnium-containing metal layer. However, review of the relied upon text reveals that Tsunashima merely describes forming a metal silicate film by LPCVD (low pressure chemical vapor deposition). In contrast, claim 20 sets forth initially forming a hafnium-containing metal layer that is distinguished by the express terms of claim 20 from a hafnium oxide layer. The metal silicate film of Tsunashima clearly does not disclose the metal layer of claim 20. Subsequent to forming the metal silicate film, the relied upon text of Tsunashima also describes forming a metal oxide film. However, the metal oxide film of Tsunashima also does not disclose the metal layer of claim 20.

The Office Action does not identify any other portion of Tsunashima or other reference supporting the allegation that the prior art discloses initially forming a hafnium-containing metal layer as a part of forming a hafnium-containing dielectric layer consisting of hafnium oxide, as set forth in claim 20. At least for such reasons, Tsunashima fails to disclose or suggest every limitation of claim 20. Ma does not remedy such deficiencies of Tsunashima and the cited combination cannot thus be considered to disclose or suggest subject matter that is absent from both.

Claims 21, 22, 24, and 25 depend from claim 20 and are patentable at least for such reason as well as for the additional limitations of such claims not disclosed or suggested. For example, claim 21 sets forth that forming the hafnium-containing metal layer and forming the lanthanum-containing metal layer both include physical vapor

deposition. Pages 6-7 of the Office Action allege that column 6, lines 45-55 disclose such physical vapor deposition. However, those of ordinary skill know that LPCVD does not constitute a form of physical vapor deposition.

Claim 54 sets forth a method for forming a MOS transistor that includes, among other features, forming a dielectric layer consisting of hafnium oxide overlying a surface containing silicon, forming a dielectric layer consisting of lanthanum oxide on and in contact with the hafnium oxide dielectric layer, and forming a gate electrode over the hafnium oxide and the lanthanum oxide dielectric layers. As may be appreciated from the discussion above regarding the deficiencies of Tsunashima in view of Ma as applied to claims 1 and 52, the combined references fail to disclose or suggest every limitation of claim 54.

Claim 55 sets forth a method for forming a MOS transistor that includes, among other features, forming a layer consisting of hafnium on and in contact with a surface containing silicon, oxidizing the hafnium layer into a dielectric layer consisting of hafnium oxide, forming a lanthanum-containing dielectric layer on and in contact with the hafnium oxide dielectric layer, and forming a gate electrode over the hafnium oxide and lanthanum-containing dielectric layers. As may be appreciated from the discussion above regarding the deficiencies of Tsunashima in view of Ma as applied to claims 1 and 52, the combined references fail to disclose or suggest every limitation of claim 55.

Claim 60 depends from claim 52 the subject matter of which is discussed above. As may be appreciated, claim 52 is patentable over Tsunashima in view of Ma and claim 60 is also patentable by its dependence as well as for the additional limitations of such claim not disclosed or suggested.

Claims 15, 19-22, 24, 25, 54, 55, and 60 are patentable over Tsunashima in view of Ma and Applicant requests allowance of such claims in the next Office Action.

Claims 3-5, 23, 26, 27, 29-31, and 58 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Tsunashima and Ma as applied to claim 20 and in further view of Kaushik. Applicant requests reconsideration.

Claim 3 sets forth a method of forming a dielectric layer that includes, among other features, forming a layer of silicon dioxide overlying at least one portion of a silicon-containing surface of a substrate, forming a metal layer over the layer of silicon dioxide, and heating the metal layer and layer of silicon dioxide to a temperature of from about 200° C to less than 400° C. The method includes combining metal of the metal layer with oxygen of the silicon dioxide layer to form a metal oxide dielectric layer included in a first metal-containing dielectric layer over the surface. All the metal of the first dielectric layer consists of at least one element selected from Group IVB. The method further includes forming a second metal-containing dielectric layer on and in contact with the first metal-containing dielectric layer. All the metal of the second dielectric layer consists of at least one element selected from Group IIIB. Pages 7-8 of the Office Action allege that Tsunashima in view of Ma discloses every limitation of claim 3 except for using oxygen of the silicon dioxide layer to form a metal oxide dielectric layer and relies upon Kaushik to disclose the missing subject matter. Applicant traverses.

Page 7 of the Office Action incorrectly alleges that metal silicate film 6 of Tsunashima discloses forming a metal oxide dielectric material included in a first dielectric layer. However, column 4, lines 60-63 and column 5, lines 24-30 of Tsunashima require metal silicate film 6 to include silicon in addition to a metal and

oxygen. As known to those of ordinary skill, silicon is not a metal. Accordingly, metal silicate film 6 does not disclose a metal oxide dielectric material included in a first dielectric layer, as set forth in claim 3. Kaushik does not disclose or suggest the claimed metal oxide dielectric material. At least for such reason, the combined references fail to disclose every limitation of claim 3.

In addition, page 8 of the Office Action incorrectly alleges that Kaushik discloses combining metal of the metal layer with oxygen of the silicon dioxide layer to form a metal oxide dielectric material, as set forth in claim 3. Column 3, lines 13-24 of Kaushik clearly describe that the combining of silicon dioxide and metal in Kaushik involves diffusing a metal layer into a silicon dioxide layer at a temperature of from about 400° C up to about 1000° C. In general, the result of diffusing metal into silicon dioxide is to form a silicate material as described in column 3, lines 36-40 of Kaushik. Such is especially the case in Kaushik since column 2, lines 58-59 state that the metal should be thermodynamically stable with silicon dioxide. That is, it should not react with, reduce, etc. the silicon dioxide. Instead, the metal merely "impregnates" the silicon dioxide as described in column 3, line 24-27 and elsewhere throughout Kaushik.

In contrast, the method of claim 3 sets forth combining metal of the metal layer with oxygen of the silicon dioxide layer to form a metal oxide. A metal oxide is patentably distinguished from a silicate material. The difference in the intent of Kaushik is further made clear from its statement in column 3, lines 8-12 that optimal metal concentration in the silicon dioxide is from 4% to 15% metal. Kaushik does not state whether such is atomic or weight percent. Regardless, Applicant notes that Group IVB metal oxides, such as set forth in claim 3, contain a minimum of 33 atomic% metal (TiO_2, ZrO_2, and HfO_2) and a minimum of 60 weight% metal (TiO_2). Thus, Kaushik

does not contemplate forming metal oxide from its diffusion or impregnation of metal into silicon dioxide. Page 7 of the Office Action acknowledges that Tsunashima in view of Ma does not disclose combining metal of the metal layer with oxygen of the silicon dioxide layer to form a metal oxide. At least for such additional reason, the combined references fail to disclose or suggest every claim limitation.

Further, claim 3 sets forth heating the metal layer and silicon dioxide to a temperature of from about 200° C to less than 400° C. The diffusion step of Kaushik thus occurs at a higher temperature compared to the heating in claim 3. Paragraph [0034] along with paragraphs [0025] and [0033] of the present specification describe that heating a metal layer and silicon dioxide to a temperature of from about 200° C to less than 400° C results in combining metal of the metal layer with oxygen of the silicon dioxide layer to form a metal oxide. The heating in claim 3 may thus be contrasted with the higher temperature diffusion step of Kaushik that instead impregnates the metal into the silicon dioxide, resulting in formation of a silicate material.

Kaushik thus fails to disclose forming a metal oxide dielectric material since it only describes forming a silicate material by a diffusion step. Kaushik also fails to disclose heating a metal layer and silicon dioxide at a temperature of from about 200° C to less than 400° C, as set forth in claim 3. Page 8 states that it would be obvious to discover the claimed optimum range. However, failure to provide the higher temperature diffusion step of Kaushik and to form a silicate material would frustrate an intended purpose of Kaushik. Thus, no motivation can be deemed to exist to modify the express teachings of Kaushik and instead heat at the claimed lower temperature to form a metal oxide dielectric material. Based upon the express teachings of Kaushik, those of ordinary skill would find that failing to provide the higher temperatures

described by Kaushik would prevent proper formation of the desired silicate material. Page 7 of the Office Action acknowledges that Tsunashima in view of Ma does not disclose the claimed temperature range. At least for such further reason, the combined references fail to disclose or suggest every claim limitation.

Claims 4 and 5 depend from claim 3 and are patentable at least for such reason as well as for the additional limitations of such claims not disclosed or suggested.

Claims 23, 26, 27, and 29-31 depend from claim 20 the subject matter of which is discussed above as patentable over Tsunashima in view of Ma. Kaushik fails to remedy the deficiencies of Tsunashima in view of Ma and claims 23, 26, 27, and 29-31 are thus patentable by their dependence from claim 20 as well as for the additional limitations of such claims not disclosed or suggested. As may be appreciated from the discussion above regarding the deficiencies of Tsunashima in view of Ma and further in view of Kaushik, claim 58 is also patentable. Applicant requests allowance of claims 3-5, 23, 26, 27, 29-31, and 58

Claims 20, 54, and 55 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Yao. Applicant requests reconsideration.

The subject matter of claims 20, 54, and 55 is discussed above. Page 10 of the Office Action alleges that column 12, line 9-20 of Yao discloses forming a MOS transistor comprising a dielectric layer consisting of hafnium oxide. However, Applicant asserts that Yao fails to disclose or suggest such a MOS transistor. Applicant further asserts that the Office Action fails to reference any portion of Yao by column and line number that discloses or suggests a MOS transistor containing the laminated structure of Yao. Review of column 11, line 57 to column 12, line 27 reveals that Yao merely describes a laminated structure used to pattern various electronic elements or devices.

Applicant asserts that Yao fails to disclose or suggest any use of a laminated structure within or otherwise as a part of an electronic element or device. Yao certainly does not suggest forming a gate electrode over the laminated patterning structure. Instead, the underlying substrate that is patterned using the Yao laminated structure is used in subsequently formed devices such as the transistor, DRAM, or FRAM mentioned on page 10 of the Office Action. The laminated structure is not disclosed as being included in such devices. At least for such reason, Applicant asserts that claims 20, 54, and 55 are patentable over Yao.

Applicant herein establishes adequate reasons supporting patentability of claims 1-31, 52, and 54-62 and requests allowance of all such pending claims in the next Office Action.

Respectfully submitted,

Dated: 21 Dec 2004 By: _____
James E. Lake
Reg. No. 44,854